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Automated Tuning IO Parameters for Line X-C

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Heath Watkins, LANL

12/7/2021

Goals

To determine the parameters that are needed for tuning the beam, and devise a structure sufficient for accessing, reading, and writing those parameters.

The main problem here is that the beam physicist (BP) is the best, and only, agent who can determine which parameters they want to use to tune.

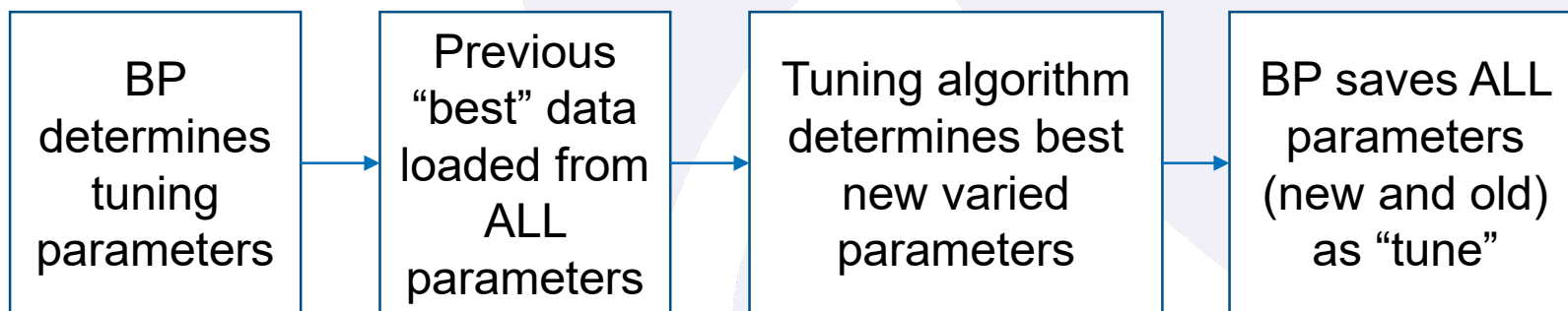
BP
determines
tuning
parameters

What is a “tune”?

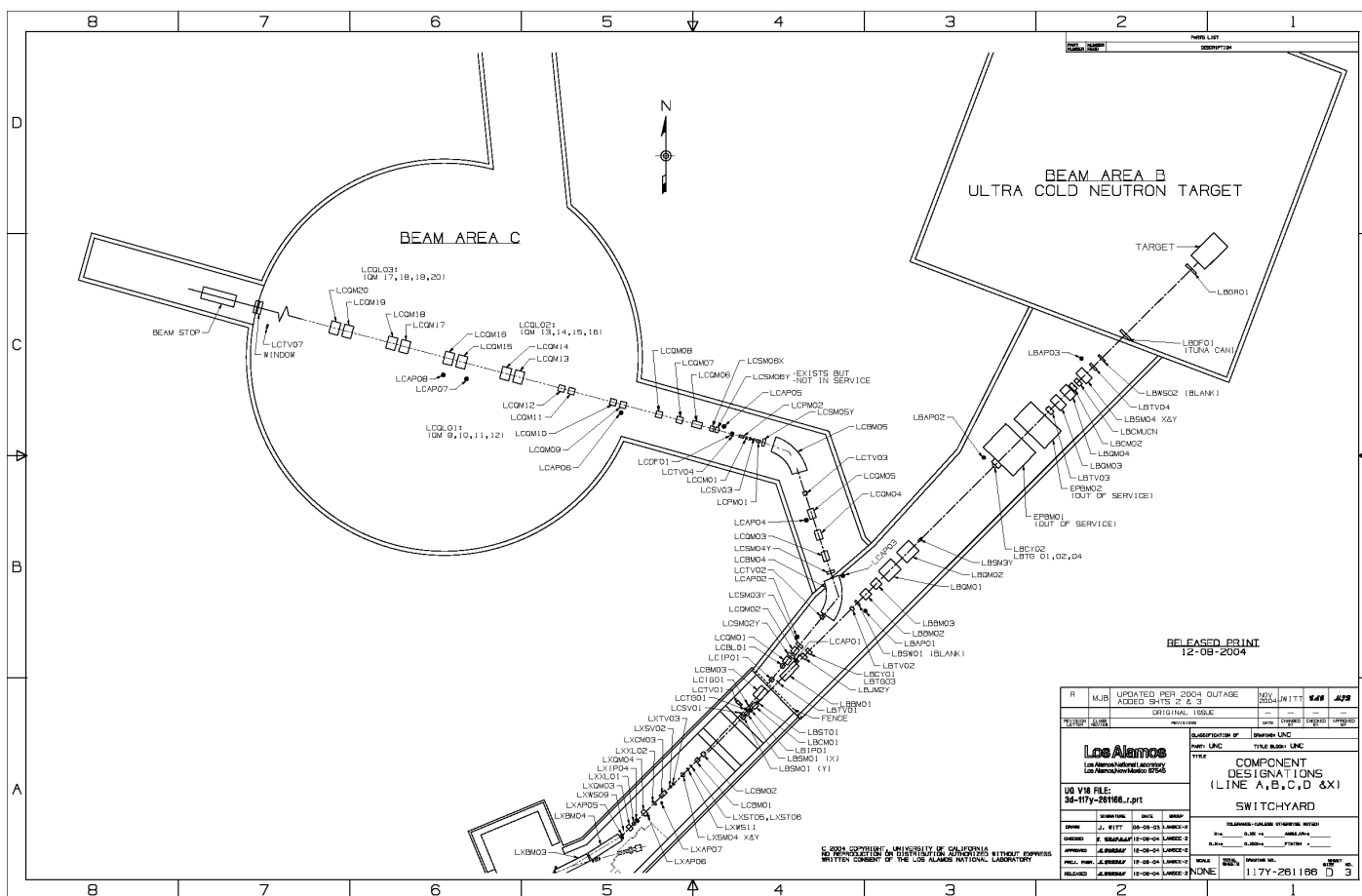
(from a software standpoint)

Since the “best tuning parameters” are specifically associated with the parameters the beam physicist decided to change AND the parameters they chose to keep fixed, a given “tune” is actually a set of all relevant machine parameters, a list of which parameters are being varied, and the initial and final values for both sets of parameters.

Also includes metadata i.e. date/time/beam characteristics/etc...



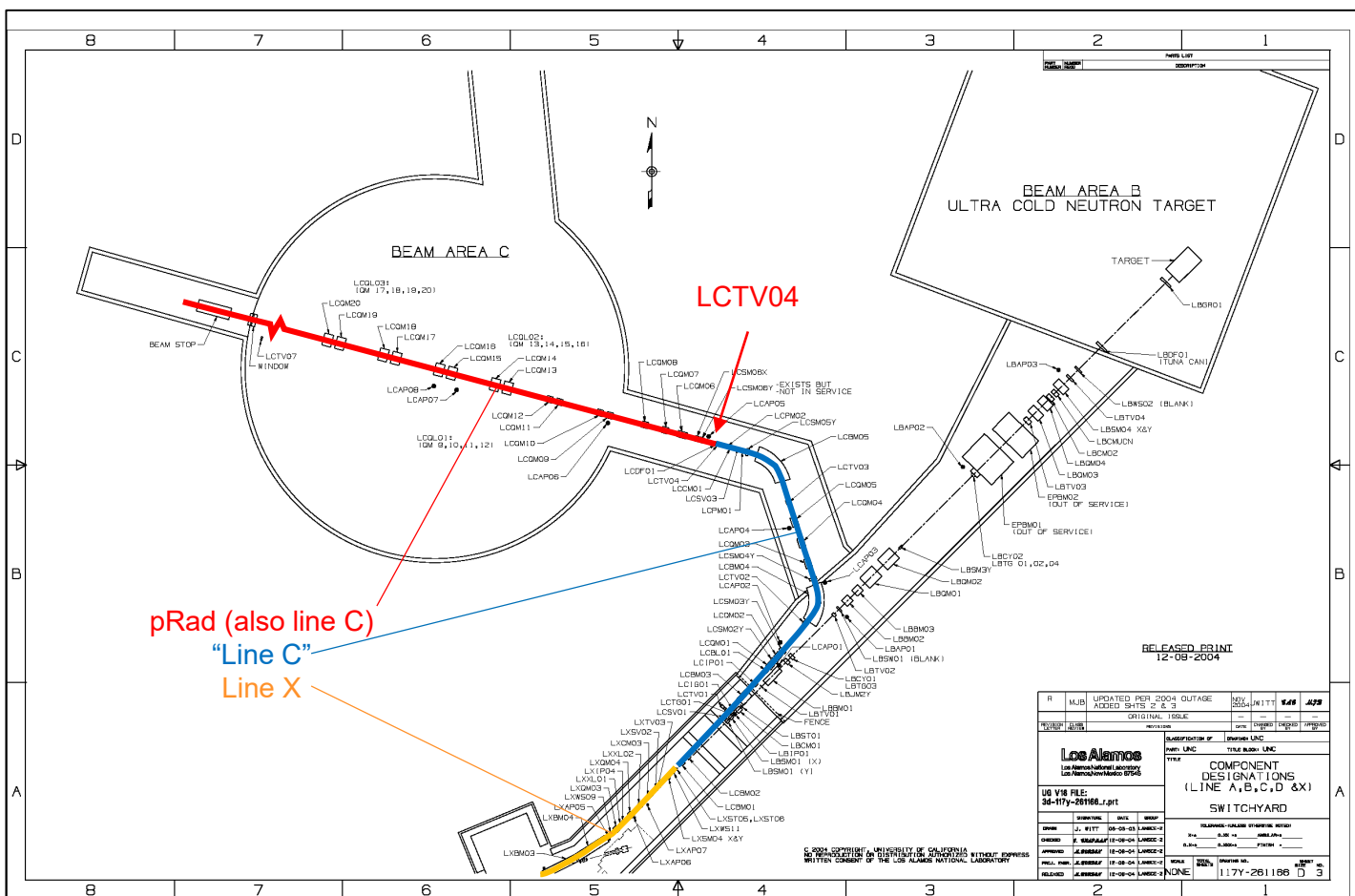
Line X - C



Overall map of the end of line X and lines B and C

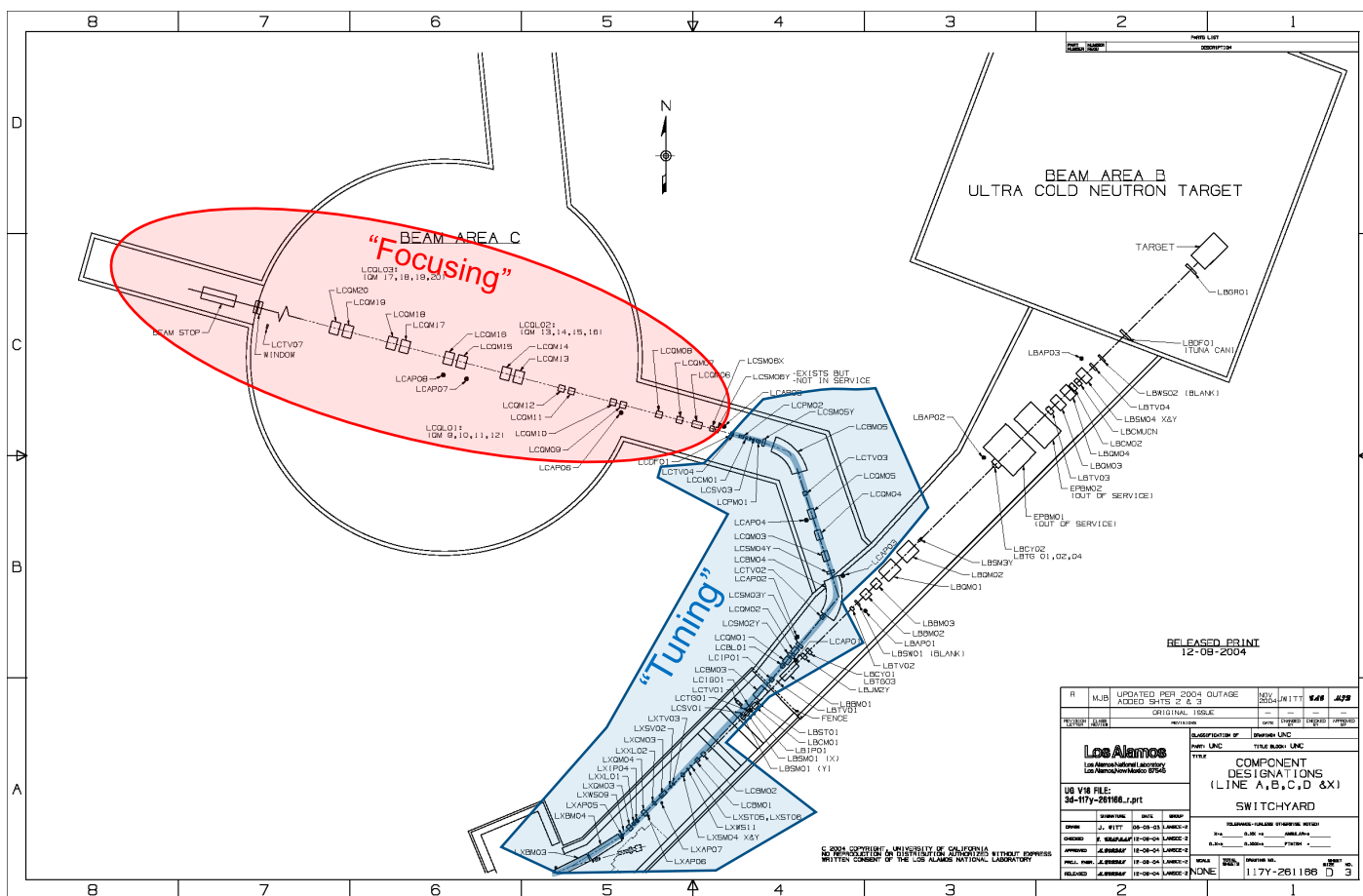
This picture is slightly outdated. More accurate version available, but unnecessary at this step.

Line X - C



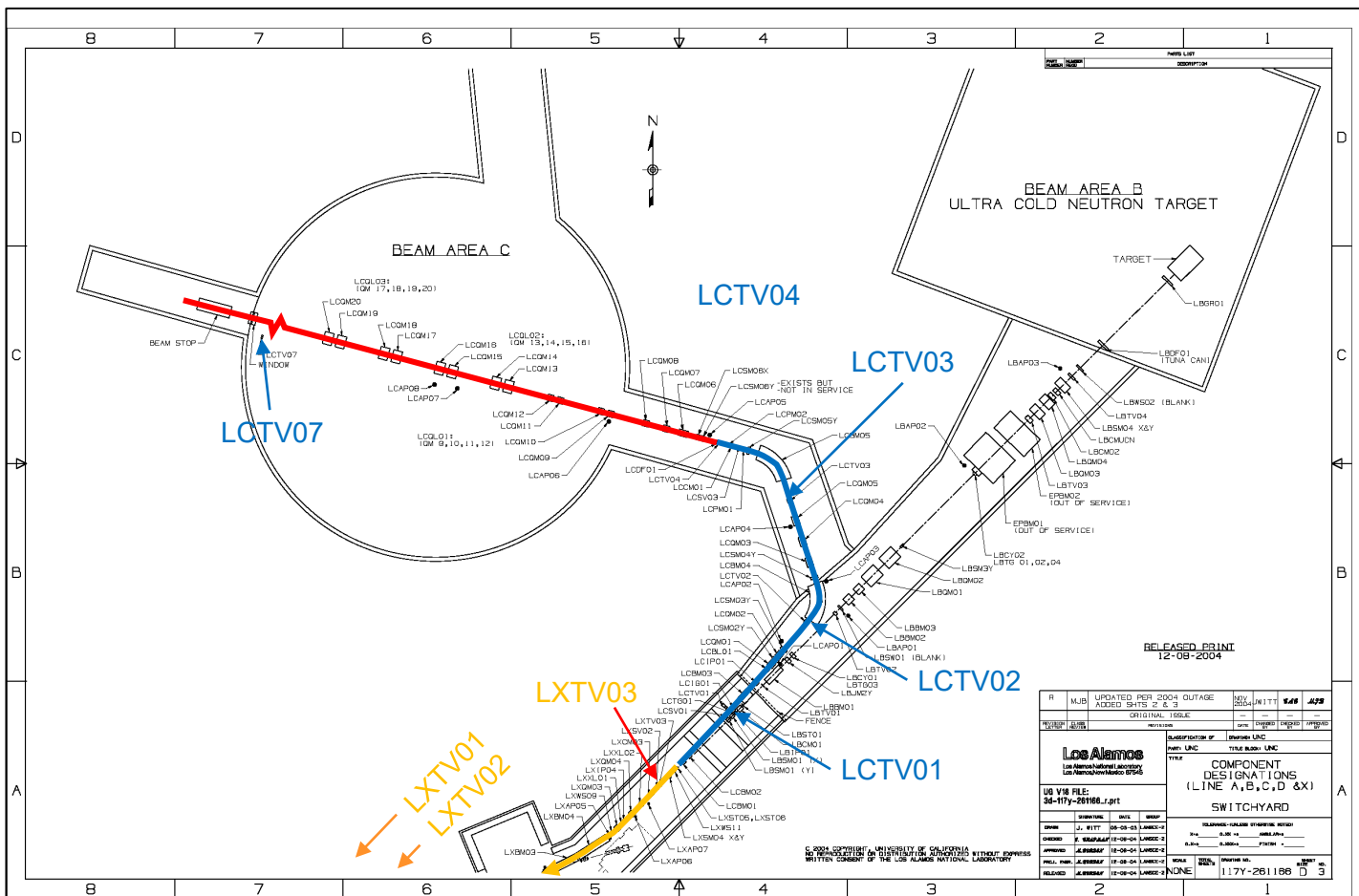
Division of “responsibility” along lines X and C. “Beam Tuning” operators generally refer to everything before LCTV04, but this is not necessarily a hard rule.

Line X - C



Division of “responsibility” along lines X and C. “Beam Tuning” operators generally refer to everything before LCTV04, but this is not necessarily a hard rule.

Phosphor+TV positions along Line X-C



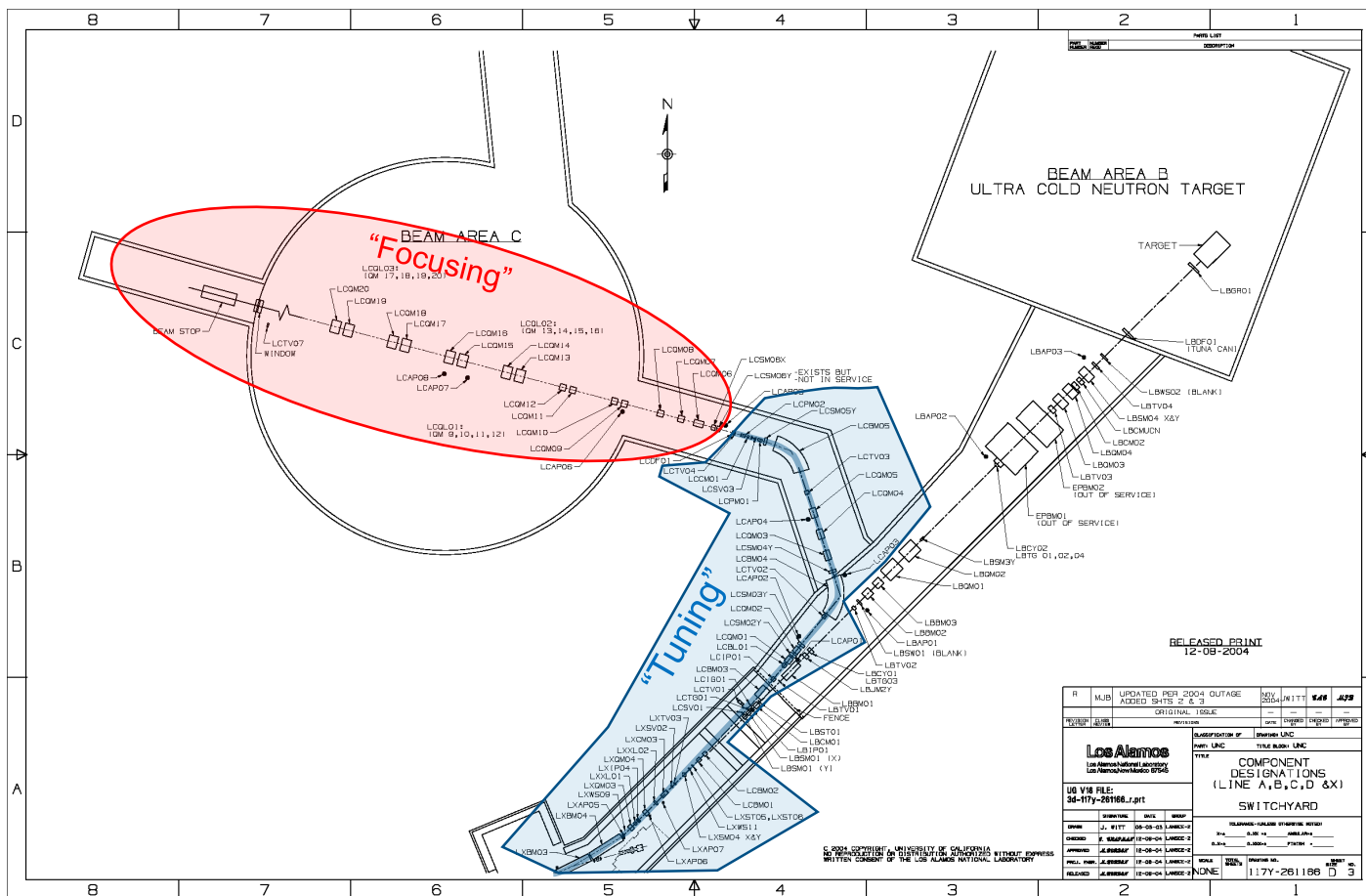
Phosphor + TV positions along line X and C
Used for piecewise tuning/focusing elements before each TV

What things are

TV	Television + Phosphor (insertable/removable)
CM	Current Monitor
DF	Diffuser
AP	Loss Monitor
IG	Ion Gauge (vacuum)
IP	Ion Pump
KI	Kicker
BM	Bending Magnet
SM	Steering Magnet

QM	Quadrupole Magnet
PM	Position Monitor (BPM, BPPM)
BS	Beam Stop
SV	Solenoid Valve
TG	Vacuum Thermocouple
WS	Wire scanner
ST	Beam stripper
XM	Transmission monitor
XL	Transmission limiter

Line X - C



Approximately 80 devices labeled in this picture, more existing upstream to LXBM000

LANSCE-RM Device Database System

<http://db.lcs.lanl.gov/pvrprt/>

Allows for obtaining PV names and descriptions from device names.

For this example, we are selecting “LCTV1” and a series of relevant channel column info.

This is important for constructing the “TV” object datatype that we will use to access and live analyze phosphor data.

Cameras are *mostly* standardized in terms of PV names, but other devices can be less so. An effort will need to be made to go through every device to match PV names to the intended device control parameter.

LANSCE-RM Device Database System

Home Login Channel Component LCS Actuator Wire Info TF IOC Info Archiver About

Home > Channel Report Template

Channel Report Template

IOCs (626)	Rec Type	0-8 Field(s) to Add (Default: DESC, DTYP, INP, OUT)	Text Input - (*, ?) accepted
01tdaq 01tdaq2 01tdaq2f 01tdaqf 02tdaq 02tdaqf 03tdaq 03tdaqf 04tdaq 04tdaqf 05bppm3 05bppm3f 05tdaq 05tdaq2 05tdaq2f 05tdaq3 05tdaq3f 05tdaqf 06bppm2 06bppm2f 06bppm3 06bppm3f 06bpm4	aai aao advisor ai ao apply aSub asyn bi bo cad calc calcout car compress compressRavStd dfanout epid event fanout genSub histogram knob	DCPR DCPV DDCV DDEU DDHR DDLRL DDLRL DDNE DDNV DDPR DDPV DECV DEEU DEHR DELR DELV DENE DENV DEPCMT DEPDAT DEPR DEPV DESC	One or Multiple Channel Patterns LCTV001* Value to Match in Selected Fields

Select All Clear All Select All Clear All Z→A Order High→Low Freq

☐ History Mode

Get Report

Tips: (1) By clicking the **Get Report** button without selecting any item in the three dropdown lists and without inputting anything in text slots, you can get a default report which includes the columns of channel name, channel type, IOC name, DESC, DTYP, INP, and OUT. (2) wildcards "*" or "?" are allowed in the text fields to match anything. If the pattern itself has "*" or "?", use "*" or "\?" instead. (3) For the channel text field, you are allowed to input more than one patterns separated by lines, that is, one line has one pattern.

LANSC-E-RM Device Database System

<http://db.lcs.lanl.gov/pvrprt/>

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For this example, we are selecting “LCTV1” and a series of relevant channel column info.

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Cameras are *mostly* standardized in terms of PV names, but other devices can be less so. An effort will need to be made to go through every device to match PV names to the intended device control parameter.

LANSC-E-RM Device Database System

HomeLoginChannelComponentLCSActuatorWire InfoTF IOC InfoArchiverAbout

Home > Channel Report > Channel Report Results

ch	Channel	Ch Type	IOC	DESC	DTYP	EGU	INP	OUT
<input type="radio"/>	LCTV001B04	bo	ebcams	Capture live image as BG	SM Device			@53
<input type="radio"/>	LCTV001B09	bo	ebcams	Capture image	SM Device			@52
<input type="radio"/>	LCTV001B10	bo	ebcams	Save stored image to file	SM Device			@51
<input type="radio"/>	LCTV001BGCopied	calcout	ebcams	CalcOut Record				LCTV001D10.PROC NPP NMS
<input type="radio"/>	LCTV001BGobtained	bi	ebcams	binary input record	SM Device		@53	
<input type="radio"/>	LCTV001CapCopied	calcout	ebcams	CalcOut Record				LCTV001D02.PROC NPP NMS
<input type="radio"/>	LCTV001CapDone	bi	ebcams	binary input record	SM Device		@52	
<input checked="" type="radio"/>	LCTV001D01	waveform	ebcams	Live Image	SM Device	units	@50 0	
<input type="radio"/>	LCTV001D02	waveform	ebcams	Captured Image	SM Device	units	@51 0	
<input type="radio"/>	LCTV001D03	ai	ebcams	Background	SM Device	units	@54	
<input type="radio"/>	LCTV001D04	ai	ebcams	Background	SM Device	units	@59	
<input type="radio"/>	LCTV001D05	waveform	ebcams	Captured Image X Profile	SM Device	units	@55 0	
<input type="radio"/>	LCTV001D06	waveform	ebcams	Captured Image Y Profile	SM Device	units	@56 0	
<input type="radio"/>	LCTV001D07	waveform	ebcams	Live Image X Profile	SM Device	units	@50 0	
<input type="radio"/>	LCTV001D08	waveform	ebcams	Live Image Y Profile	SM Device	units	@51 0	
<input type="radio"/>	LCTV001D09	waveform	ebcams	Subtracted Image	SM Device	units	@53 0	
<input type="radio"/>	LCTV001D10	waveform	ebcams	Background Image	SM Device	units	@52 0	
<input type="radio"/>	LCTV001L01	bo	m71iioB	ILLUMINATION	cRIO IIO			#C6 S0 @Latch Back 100 ms #C1 S8
<input type="radio"/>	LCTV001L02	bo	m71iioB	PHOSPHOR	cRIO IIO			#C5 S7 @Latch Back 5000 ms #C1 S7
<input type="radio"/>	LCTV001L03	bi	m71iioB	PHOSPHOR	cRIO IIO		#C3 S5	
<input type="radio"/>	LCTV001Name	stringout	ebcams	string output record	SM Device			@54
<input type="radio"/>	LCTV001P01	longout	ebcams	ROI X start SET0	SM Device	pixels		@250
<input type="radio"/>	LCTV001P02	longout	ebcams	ROI X end SET0	SM Device	pixels		@251
ch	Channel	Ch Type	IOC	DESC	DTYP	EGU	INP	OUT

<< prev 1000 recnext 1000 rec >>Total: 44Page 1of 1Ordered by Channel ↓Chan InfoDBPR cmdCRIO WirePrint

Tips: By clicking a table header, you can sort the records with their respective columns either by ascending order or by descending order in toggle.

LANSC-E-RM Device Database System

<http://db.lcs.lanl.gov/pvrprt/>

LANSC-E-RM Device Database System								
Home	Login	Channel	Component	LCS	Actuator	Wire Info	TF IOC Info	Archiver About
Home > Channel Report > Channel Report Results								
ch	Channel	Ch Type	IOC	DESC	DTYP	EGU	INP	OUT
<input type="radio"/>	LCSM002absCurr	calcout	sysoft	CalcOut Record				LCSM002curramp PP NMS
<input type="radio"/>	LCSM002B01	bo	sysoft	On/Off Control SET0	Soft Channel			0.000000000000000e+00
<input type="radio"/>	LCSM002B02	bo	sysoft	Local/Remote Ctrl SET0	Soft Channel			0.000000000000000e+00
<input type="radio"/>	LCSM002clrSts	stringout	sysoft	Clear status registers	stream			@Sorensen.proto clear LCSM002
<input type="radio"/>	LCSM002curramp	ramp	sysoft	Current Ctrl SET0 SET0.OUTV		Amps		
<input type="radio"/>	LCSM002currspLim	ao	sysoft	Curr Lim Setpoint SET0	stream	Amps		@Sorensen.proto setCurrentLimit LCSM002
<input type="radio"/>	LCSM002currspLimValue	ai	sysoft	Curr Lim Setpoint	stream	Amps	@Sorensen.proto getCurrentLimit LCSM002	
<input checked="" type="radio"/>	LCSM002currspValue	ai	sysoft	Current Setpoint	stream	Amp	@Sorensen.proto getCurrent LCSM002	
<input type="radio"/>	LCSM002curscale	calc	sysoft	Scaled Setpoint SET0 SET0.A		Amps		
<input type="radio"/>	LCSM002curset	ao	sysoft	Current setpoint SET0	stream	Amp		@Sorensen.proto setCurrent LCSM002
<input type="radio"/>	LCSM002enaCalc	calcout	sysoft	Enable Expert PVs				LCSM002xBypass.PROC PP NMS
<input type="radio"/>	LCSM002erBypass	bi	sysoft	Bypass Error String PVs	Soft Channel		0.000000000000000e+00	
<input type="radio"/>	LCSM002erCalc	calcout	sysoft	Enable Error String Read				LCSM002erBypass.PROC PP NMS
<input type="radio"/>	LCSM002error1	stringin	sysoft	Latest Error String	stream		@Sorensen.proto getLastError LCSM002	
<input type="radio"/>	LCSM002error10	stringin	sysoft	10th Error String	Soft Channel		LCSM002error9.VAL NPP NMS	
<input type="radio"/>	LCSM002error2	stringin	sysoft	2nd Error String	Soft Channel		LCSM002error1.VAL NPP NMS	
<input type="radio"/>	LCSM002error3	stringin	sysoft	3rd Error String	Soft Channel		LCSM002error2.VAL NPP NMS	
<input type="radio"/>	LCSM002error4	stringin	sysoft	4th Error String	Soft Channel		LCSM002error3.VAL NPP NMS	
ch	Channel	Ch Type	IOC	DESC	DTYP	EGU	INP	OUT
<< prev 1000 rec next 1000 rec >> Total: 81 Page 1 of 1 Ordered by Channel ↓ Chan Info DBPR cmd CRIO Wire Print								

Similar table for LC steering magnet 2, i.e. LCSM002.

PV info is also displayed for the selected PV. Here we have the current setpoint value readback value selected.

Channel Info	
RICE Cable # VS. Terminal	
Field	Value
ADEL	0.000000000000000e+00
AOFF	0.0000000e+00
ASLO	1.0000000e+00
DESC	Curr Lim Setpoint
DISS	NO_ALARM
DISV	1
DTYP	stream
EGU	Amps
EGUF	0.0000000e+00
EGUL	0.0000000e+00

Tips: By clicking a table header, you can sort the records with their respective columns either by ascending order or by descending order in toggle.

To do:

- Go through and tally/list the actual current existing tuning-relevant devices for all of lines X and C.
- Categorize each into a device type into an object which contains ALL necessary properties that must be stored and set into each PV for the tuning algorithm, and identify each as input or output parameters.
- Identify POSITIONS along the beam path for each device, or identify a ranking system. This will be necessary to ensure that operators cannot attempt to optimize a beam metric using a beam parameter that is downstream from that metric
 - For instance, a steering/bending/focusing magnet downstream from an intercepting TV/phosphor cannot be included in the optimization of that phosphor's image position. Same applies to current/loss monitors, position monitors, etc...
- Use the list and the object definitions to build an overall data structure for a given tune, along with packing/unpacking and read/write functions that use that data to build/access PV monitors and streaming PV setting functions for those PVs